

46ESS-54: Hybrid Space Propulsion Systems

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In the context of space propulsion, “hybrid” refers to both Hybrid Propellant Rockets and Hybrid Air-Breathing Rocket Engines. The work focuses on the latter as a promising alternative to the conventional rocket technologies as far as the launch segment is concerned. A substantial reduction of the on-board stored oxidizer is achievable by using atmospheric air during the first part of the ascending trajectory, leading to Single Stage To Orbit design. Versatility, reusability and lightweight represent the most significant advantages of this hybrid architecture. The aim of the work is to present and analyse the cited aspects, after a brief introduction and historical contextualization. An extensive comparison with conventional rocket technology is carried out emphasising pros and cons. A description of the principal hybrid configurations is provided, along with a discussion upon the related achievable performance. The Hybrid Synergistic Air-Breathing Rocket Engine is examined in detail as representative of the state of the research. Engine cycle, main components and performance are treated. Eventually, the future trend is outlined.